

Non-CO₂ Greenhouse Gases: Methane

Source/Sectors: Agriculture/Enteric Fermentation

Technology: Improved feed conversion efficiency (A.3.1.2)

Description of the Technology:

Several methods can be used to improve feed conversion efficiency and, consequently, reduce methane emissions:

- Improved level of feed intake – An increase in level of feed intake can change the volatile fatty acid (VFA) content in the rumen and less acetate and more propionate is formed resulted in lower methane production and emissions (de Jager *et al.*, 2001).
- Replacing roughage with concentrates – Roughage contains a high level of structural carbohydrates (fibers). Replacing part of the roughage in the animal diet with concentrates can improve propionate generation and reduce methane production and emissions (Cole *et al.*, 1996; Cole *et al.*, 1997; de Jager *et al.*, 2001).
- Changing composition of concentrates – Adding unsaturated fatty acid and/or lipids (high fat diet) to the animal diet can increase the formation of propionate and reduce methane production and emissions (de Jager *et al.*, 2001; Bates, 2001).
- Alkali/ammonia/urea treatment of low quality roughage – The digestibility of low quality roughages such as straw can be improved by treatment using chemicals such as sodium hydroxide, ammonium hydroxide, and urea. Substantial methane reduction is feasible in combination with livestock reduction (de Jager *et al.*, 2001; Bates, 2001).
- Chopping of low quality crop by-products – Physical modifications of straws and other crop-by-product by chopping and milling can also improve feed intake and animal performance and result in less methane production and emissions (Cole *et al.*, 1996; Cole *et al.*, 1997; de Jager *et al.*, 2001).
- Wrapping and preserving rice straw – By wrapping freshly-cut and urea-treated straw in bales, its nutritive value can be better retained and spoilage is prevented (de Jager *et al.*, 2001; Bates, 2001).

Effectiveness: Good

Implementability: Fair

Reliability: Fair

Maturity: Fair

Environmental Benefits: Methane emission reduction

Cost Effectiveness: None reported.

Industry Acceptance Level: Fair

Limitations: None reported.

Sources of the information:

1. Bates, J. (2001) "Economic Evaluation of Emission Reductions of Nitrous Oxide and Methane in Agriculture in the EU: Bottom-up Analysis", a final report to European Commission.
2. California Energy Commission (2005) "Emission Reduction Opportunities for Non-CO₂ Greenhouse Gases in California", a report prepared by ICF Consulting for California Energy Commissions, CEC-500-2005-121, July 2005.
3. Cole, C.V.; Duxbury, J.; Freney, J.; Heinemeyer, O.; Mosier, A.; Paustian, K.; Rosenberg, M.; Sampson, N.; Sauerbeck, D.; Zhao, Q. (1997) "Global Estimates of Potential Mitigation of Greenhouse Gas Emissions by Agriculture", *Nutrient Cycle in Agroecosystems*, 52, 221-228.
4. Cole, V.; Cerri, C.; Minami, K.; Mosier, A.; Rosenberg, N. *et al.* (1996) "Chapter 23 – Agricultural Options for Mitigation of Greenhouse Gas Emissions" in *Climate Change 1995. Impacts, Adaptions and Mitigation of Climate Change: Scientific-Technical Analyses*. IPCC Working Group II, Cambridge Univ. Press.
5. de Jager, D.; Hendriks, C.A.; Byers, C. ; van Brummelen, M.; Petersdorff, C. ; Strucker, A.H.M.; Blok, K.; Oonk, J ; Gerbens, S.; Zeeman, G. (2001) "Emission Reduction of Non-CO₂ Greenhouse Gases", Dutch National Research Programme on Global Air Pollution and Climate Change, Report no. 410-200-094.
6. http://www.maf.govt.nz/mafnet/rural-nz/sustainable-resource-use/climate/greenhouse-gas-policies/greengas-14.htm#P1797_148161
7. http://www.maf.govt.nz/mafnet/rural-nz/sustainable-resource-use/climate/abatement-of-agricultural-greenhouse-gas-emissions/abatement-of-agricultural-greenhouse-gas-emissions-19.htm#P4056_323708
8. International Energy Agency (2003) "Building the Cost Curves for the Industrial Sources of Non-CO₂ Greenhouse Gases", Report Number PH4/25, IEA Greenhouse Gas R&D Programme, Cheltenham, United Kingdom, October 2003.
9. Leng, R. A. (1993) "Quantitative ruminant nutrition - A green science", *Australian Journal of Agricultural Research*, 44: 363-80, 1993.
10. U.S. Climate Change Technology Program (2005) "Technology Options for the Near and Long Term", U.S. Department of Energy, <http://www.climatechange.gov/index.htm>, August 2005.
11. U.S. Environmental Protection Agency (1999) "Report on U.S. Methane Emissions 1990-2020: Inventories, Projections, and Opportunities for Reductions", United States Environmental Protection Agency, EPA 430-R-99-013, September 1999.
12. U.S. Environmental Protection Agency (2004) "International Methane and Nitrous Oxide Emissions and Mitigation Data", United States Environmental Protection Agency. Available online at www.epa.gov/methane/appendices.html (in Excel file).
13. U.S. Environmental Protection Agency (2006a) "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 to 2004", Office of Atmospheric Programs, United States Environmental Protection Agency, EPA-430-R-06-002, June 2006.
14. U.S. Environmental Protection Agency (2006b) "Global Mitigation of Non-CO₂ Greenhouse Gases", Office of Atmospheric Programs, United States Environmental Protection Agency, EPA-430-R-06-005, June 2006.